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Opportunities for Materials Science using a Fully Coherent Hard X-ray Laser

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The limited coherence and broad bandwidth of present sources of hard X-rays impose serious limits on the fundamental development of x-ray probes addressing challenges in materials science. An X-ray source producing hard X-rays with complete transverse and longitudinal coherence would overcome many of these limitations and provide new insight into structure and dynamics, particularly in techniques based on single-shot imaging, coherent scattering, and microscopy. We will discuss the potential to use the coherence, tunability, narrow bandwidth, and high-repetition rate of the proposed X-ray free electron laser oscillator (XFELO) in the dynamics of electronic materials.